

1.
 - (a)
 - A.....Endodermis [1]
 - B.....Cortex [1]
 - C.....Casparian strip [1]
 - D.....Epidermis [1]
 - (b)
 - (i) Uptake by active transport [1]
 - (ii) Symplast [1]

(Ions taken) into cell cytoplasm and carried through plasmodesmata [1]

Apoplast [1]

Ions carried (in solution) along/through cell walls. [1]
(allow: through gaps in cell walls; **not:** gaps between cell walls/holes)
 Need correct description with name.
 - (c)
 - (i) 500 times. [1]
 - (ii) Draws water into the plant; [1]

by providing a WP gradient (or osmotic potential)/powers transpiration stream. [1]
 - (iii) It blocks the apoplast pathway/passes solution into symplast/cannot travel in cell wall so forces into cytoplasm . [1]
 - (iv) (Symplast) contains living cells/plasmamembrane/cell membrane [1]

Allowing selective absorption to take place/regulation of ions/active uptake.**(not:** ref. to viruses/unwanted substances etc.) [1]

[Total mark 15]

2.

- (a) A Xylem vessel (element / cell); [1]
Transport water / mineral ions or salts (allow: support); [1]
(not: nutrients)
- B Sieve tube (element / cell); (not: phloem) [1]
Transport of organic materials / sugars/ products of photosynthesis/
amino acids/sucrose (not: glucose) [1]
- C Companion (cell); [1]
Makes proteins / ATP/ release energy (for sieve tube cell); [1]
(not: make/produce energy)
- (b) Support/strengthen/
prevents vessel collapsing when water sucked along it;

waterproofing
stops water entering or leaving;

adhesion of water/hydrophilic lining (not: impermeable unequal)
aids movement of water upwards

2 linked marks [2]
- (c) Casparian strip; symplast; cohesion; adhesion; hydrophilic; [5]

3.

- (a) Choice of suitable scale with axes the right way round [1]
Correct units on axes (hrs, gh^{-1} , or g/h) [1]
Accurate plotting of points (+/- half small square). [1]
Quality of line, no extrapolation. [1]
- (b) Quantitative comparison e.g. actual values at the two times or value at 1600 is 5 times the value at 0800 [1]
Mention of difference in light intensity at the two times. [1]
Relate this to photosynthesis of K^+ pump. [1]
Causing opening of stomata / movement apart of guard cells. [1]
- (c) Increasing the temperature / lowering the humidity / air movement.
(not: heat) (*ignore light – conference*) (Any two) [2]
- (d) (i) Cohesion is the strong attraction that water molecules exert on one another. (not: stickiness) [1]
(ii) Water molecules evaporating through the stomata/transpiration at the top of the column are replaced from below [1]
and because of cohesion this creates an upward force (tension) throughout the whole column. [1]
(iii) Adhesion between the water molecules and the xylem wall. [1]
(allow: ref. cellulose/lignin. Not: friction/capillarity)
- (e) (i) Root Pressure. [1]
(ii) Active transport of ions into the root xylem. [1]
Creates an osmotic (wp) gradient / water is drawn in by osmosis at the foot of the xylem. [1]

[Total 17 marks]

4.

- (a) Time to travel 63 cm = $5 - 2 \frac{1}{2} = 2 \frac{1}{2}$ hours or 150 minutes [1]
 Rate = $63 \times \frac{2}{5}$ or $63/150$ [1]
 = 25.2 cm/hr or 0.42 cm/min [1]
 (Correct answer showing no working =3, units missing or incorrect= -1)
- (b) (i) Source – region where photosynthate/sugar/carbohydrate is produced and exported. [1]
 Sink – region where photosynthate is used/stored. [1]
- (ii) Source – leaves [1]
 Sink – roots (accept aphid colony) [1]
- (c) (i) Sucrose [1]
- (ii) Translocation [1]
- (d) Phloem and sieve tubes (allow: mesophyll and palisade cells) [2]

[Total 11 marks]

5.

- (a) Hydrophyte 1
- (b) Large air spaces in *Nymphaea*, smaller in *Ligustrum*
 (not: ref. thicker spongy mesophyll / thickness of epidermis / more air spaces)
 Stomata on upper surface of leaf in *Nymphaea*, not in *Ligustrum*
 (any 2) Comparison needed. Accept converse of points 2
- (c) Large air spaces for buoyancy/diffusion/floating
 Stomata on upper surface so allowing gas exchange with the air
 Thin cuticle as little water (vapour) loss
 (not: no cuticle)
 Little support tissue as buoyed by water
 Little xylem as surrounded by water
 Air spaces in stems allowing diffusion of gases
 (any 3) 3
- (d) Rolled leaves (not: curled)
 Hairs
 Thick cuticle
 Sunken stomata (allow: in pits not grooves)
 Deep rooted
 Extra support tissue in leaf
 (any 1) 1

Total 7 marks

6.

- | | | | |
|-----|-------|--|----------|
| (a) | (i) | Any 3 | 3 |
| | | Has a reduced surface area / surface area:volume ratio; | |
| | | <u>Thick cuticle</u> ; | |
| | | Curled / rolled (downwards with the stomata inside); | |
| | | Hairs (to trap water vapour); | |
| | (ii) | Any scientifically correct explanation of their chosen feature / | |
| | | cuticle – comment on waterproofing / | |
| | | curled – trapping water / | |
| | | SA – less area over which water can be lost / | |
| | | stomata – trapping water vapour; | 1 |
| (b) | | Xerophyte; | 1 |
| (c) | (i) | Xylem; | 2 |
| | | Transports water (and minerals); | |
| | (ii) | Phloem; | 2 |
| | | Transports carbohydrates / sugars / products of photosynthesis / | |
| | | sucrose / amino acids; | |
| | | Not glucose/nutrients | |
| | (iii) | Endodermis / starch sheath. | 1 |
| | (iv) | Decent diagram of endodermis cell; | 2 |
| | | Endodermis – with Casparian strip/band clearly labelled; | |

(v) **Any 4**

4

Waterproof / Casparian strip / band / suberin;

Blocks the apoplast pathway;

Selective uptake / Active uptake / transport of minerals (by endodermis cells);

Into symplast pathway;

Active transport of minerals into pericycle;

Water follows by osmosis;

Water and minerals move into xylem vessels;

Question Total 16

7.

- (a) A – Cortex/ parenchyma 2
 B – Endodermis;
 C – Xylem;
 D – Phloem.
 2 marks for all 4, 1 mark for 2 or 3
- (b) (i) Xylem }
 (ii) Phloem; } **Both** correct for 1 mark 1
 NOT letters only
- (c) (i) {Translocation/ movement/ transport/ carry NOT flow} of
 {products of photosynthesis/ sucrose/organic compounds/
 sugars/ amino acids}/ description of source to sink/ 1
 translocation;
 (NOT nutrients/ other named sugar/ named ions)
- (ii) Carry out {metabolism/respiration} /to supply (sieve cells) with 1
 {energy/ATP}/ contain mitochondria for {ATP/ active transport};
 NOT contain organelles that the sieve cells do not have/ not
 loading sieve cell
- (d) (i) Apoplast; – via cell walls; NOT plasmodesmata 2
 Symplast; – via {cytoplasm/ plasmodesmata}; 2
 [1 mark for name, 1 mark for correct route, for each]
- (ii) Makes the water pass through {symplast/living part of cell/
 cytoplasm}/ prevents it going through {apoplast/ cell walls}; 1
 NOT impermeable alone/ makes water take another route
- Question 3 Total [10]**

8.			
(a)		loss of water <u>vapour</u> / <u>evaporation</u> of water; from (surface of) leaf /through stomata; Accept lenticels	2
(b)	(i)	<p>TWO precautions and TWO reasons</p> <ul style="list-style-type: none"> Shoot cut under water/inserted under water/flood inside of apparatus with water/ assemble under water; to prevent air entering/ bubbles; Shoot with large number of leaves; to ensure measurable rate of transpiration; Avoid wetting leaves/ ensure leaves are dry; blocks stomata/ reduces rate of transpiration; Leave time for apparatus to settle down; allow plant to adapt to new conditions/ to equilibrate; Seal joints with Vaseline/ ensure screw clip is closed; to prevent air entering apparatus/ prevent leakage; Ensure bubble set at appropriate position/ right hand end; to enable a (suitable) reading to be taken; <p>Reference to not allowing air bubbles to enter = 1 mark (if no precautions are given)</p>	4 max
(c)	(i)	Sun(light);	1
	(ii)	<p>Molecules of water moving together/ water pulled up; Because of <u>cohesion</u> of <u>molecules</u>; <u>adhesion</u> to (walls of) {<u>xylem</u>/ hydrophilic lining/ vessel wall}; root pressure {forces/ pushes} water upwards; IGNORE capillarity</p>	2 max
(d)	(i)	A= phloem; B= xylem;	2
	(ii)	<p>{Xylem/ vascular <u>tissue</u>} is at the centre/ xylem is star shaped/ central stele; NOT bundle No vascular <u>bundles</u>/ peripheral vascular <u>bundles</u> in stem; Endodermis visible in root/ no pith;</p>	2 max
		Question 2 total	[13]

9.

(a)	(i)	sucrose is produced in (photosynthesising) leaf/ leaves are the source of sucrose; sucrose travels in phloem; phloem removed (by the ringing process); sucrose cannot flow to roots/ is blocked;	3 max
	(ii)	amino acids/hormones/ florigen;	1
(b)		sucrose used for {cell wall formation/ cell division/ mitosis/ respiration}; {Less/ no} sucrose used (by growing areas/sinks as they have been removed); therefore more will pass down stem; NOT accumulation	2 max
(c)		sucrose not replaced from above (the ring); so concentration decreases; as movement towards root continues; and sucrose used in respiration/storage/ converted to starch/ growth/ active transport;	3 max
		Question 6 Total	[9]

10.

- (a) (i) Change in mass = $11.2 - 13.6 = -2.4$; 2
% change in mass $(-2.4/13.6) \times 100 = 17.6/ 17.65 \%$;
NOT 17.7
- (ii) {greater percentage of water lost/ largest change in mass} when 3
upper surface only is covered/ when lower surface is covered there is
less change in mass;
more stomata on lower surface;
some water is lost through upper surface as{some/ few/ less} stomata
present;
- (iii) to ensure that {all of the / maximum loss of} water was lost from the 1
leaves;
- (b) (i) xerophytes/xerophytic; 1
- (ii) {lower density of/ less} stomata; 3
(rolling causes) upper epidermis to face inwards/ stomata are on the
inside of (rolled) leaf;
no stomata on {lower/exposed} surface/ all stomata on the {upper/
inner} surface;
- (iii) Any two max 2
waxy cuticle on lower surface;
reduced leaf surface area;
sunken stomata;
hairs;
long roots;

Question 5 Total

[12]

11.

(a)

Cell Type	Name of Cell Type	Function of Cell
A	(Phloem) sieve tube	Transport carbohydrate / sucrose / products of photosynthesis
B	Xylem Vessel	Transport water / mineral salts
C	Guard	Allow gaseous exchange / Allow CO ₂ in for photosynthesis / control opening and closing
D	Endodermal / endodermis	Divert water from apoplast to symplast pathway / active transport of salts from (root) (cortex to pericycle).

(8)

(b) Root.

(10)

(Total 9 marks)

12.

(a) To allow photosynthesis to take place / sufficient time for the labelled CO₂ to be metabolised to carbohydrate. (not: ref. to translocation) (1)

(b) (i) I. 38.9%
II. 4.8%
(no rounding up) (2)

(ii) fruit pod is the region of storage;
shoot apex / tip is a region of growth. (2)

(iii) In plant A twice as much carbohydrate is translocated to the fruit pod compared to plant B;
whereas in plant B more than three times of the carbohydrate is translocated to the root than in Plant A.
(Conclusions needed, not just data) (2)

(iv) Source - leaf sink fruit / shoot tip or root etc. (both needed). (1)

(v) More translocation of carbohydrate occurs from the leaves / the source, to the nearest sink or translocation from leaves occurs to the nearest sink. (1)

(Total 9 marks)

13.

- l. (a) (i) as diameter increases rate of transpiration increases;
correct reference to figures to show increase;
rate levels off / plateau / no increase as diameter increases;
reference to figures to describe plateau;

[3 max]

- (ii) wind blows away water vapour;
reference to boundary layer/shell;
increases / maintains water potential or diffusion gradient;
between leaves / air spaces in leaves and surrounding air;

[3]

- (b) (i) A = sieve tube / element / cell (not: ref. sieve plate);
B = companion cell;

[2]

- (ii) translocation;
of sucrose/amino acids;
(not: sugars/glucose/products photosynthesis)
from source to sink/named examples;
in solution/of soluble substances;
ref. to mass flow / cytoplasmic streaming;

[3 max]

(iii)	Cell A	Cell B
	x	✓
	x	x
	✓	✓
	✓	✓

[4]

Total 11

14.

- (a) (ii) rise from $4-20g/20$
4
5 times (-1 if wrong units used) 2 marks
- (iii) 0400-1900 hours 1 mark
more water transpired than absorbed;
loss of water from leaf or plant cells;
cells no longer turgid/became flaccid;
(not : plasmolysed) 3
- (b) K^+ moved into guard cells;
active process/pumped in/requires energy;
conversion of starch to malate;
lowers water potential;
water flows in by osmosis;
guard cells become turgid; 4 max

(Total 13 marks)

15.

- (a) (ii) rise from $4-20g/20$
4
5 times (-1 if wrong units used) 2 marks
- (iii) 0400-1900 hours 1 mark
more water transpired than absorbed;
loss of water from leaf or plant cells;
cells no longer turgid/became flaccid;
(not : plasmolysed) 3
- (b) K^+ moved into guard cells;
active process/pumped in/requires energy;
conversion of starch to malate;
lowers water potential;
water flows in by osmosis;
guard cells become turgid; 4 max

(Total 13 marks)

- (a) (i) both follow similar pattern;
both peak at same time;
15.00 - 15.30 hours;
29.5 and 20g peaks
rate of absorption greater between 0000 and 0400 hours or 19.00 and
24 hr or rate of transpiration greater between 0400 and 1900 hours;
3 max

16.

- (a) (i) Drawing, cell with extension.
(ii) Large SA;
(Welsh medium – surface qualified)

Large number of mitochondria (energy for active transport);
Thin cell wall, (does not interfere with flow);
Low water potential/vacuole extends into hair/
protein pumps in the membrane
(not: large vacuole) 3 Max
- (b) Cell walls; (not: cellulose)
Plasmodesmata/cytoplasm 2 marks
- (c) Casparian strip/suberin;
prevents apoplastic movement;
forces water into cytoplasm/cell;
Actively transport mineral ions into xylem vessels. 2 marks
- (d) Water moves upwards in Xylem. 1 mark

Page Break

17.

- (a) (i) Pot loses more water than leafy shoot 1
(ii) light 1
(not: ref. stomata / humidity)
(iii) Leafy shoot has stomata, (pot does not) 1
Light causes stomata to open 1
(not: ref. photosynthesis and water)
- (b) (i) Q - plasmodesma / ata 1
R - Casparian strip / band 1
(not: suberin)
(ii) Water molecules stick to each other / cohesion 1
Causes them to be pulled up / tension explained 1
(not: ref. root pressure/cohesion tension theory)
(iii) Arrows drawn inside cell walls and labelled apoplast 1
((iii) and (iv) both arrows correct route and wrong direction
1 max.)
(iv) Arrows drawn from cytoplasm to cytoplasm via
plasmodesmata and labelled symplast 1
(v) waterproof 1
(not: insoluble)
(vi) Prevents progress through apoplast / diverts flow through
symplast 1
water must pass from non-living to living part, allows plant
some control over water/ions

[12]

18.

- | | | |
|-----|---|------|
| (a) | A. Epidermis | 1 |
| | B. Palisade/Mesophyll Tissue | 1 |
| (b) | (i) II | 1 |
| | (ii) Thicker Cuticle and Sunken Stomata. (not: reference to air spaces) | 2 |
| (c) | I | 1 |
| (d) | (i) Peak around midday. | 1 |
| | Low at night. | 1 |
| | Rapid rise at dawn. | 1 |
| | (ii) Reference to malate/CO ₂ /ATP etc. | 1 |
| | Influx of potassium ions | 1 |
| | Explanation of guard cell opening e.g. asymmetric walls | 1 |
| | (iii) Temperature/humidity. (not: wind speed) | 1 |
| | | [13] |

19.

- | | | |
|-----|--|--------|
| (a) | sucrose
(not: sugar(s)/water) | 1 |
| (b) | ¹⁴ C at top of stem/ ¹⁴ C in roots
but absorbed at leaf halfway up stem | 1
1 |
| (c) | (i) growing point/growth
active process/ATP required/energy required
respiration
carbohydrate in respiratory substrate
(Any 2) | 2 |
| | (ii) sinks; | 1 |
| | | [6] |

20.

- | | | |
|-----|---|---|
| (a) | (i) root hair | 1 |
| | (ii) <u>active transport/uptake</u>
(<u>not</u> : facilitated diffusion) | 1 |
| | (iii) <u>symplast route</u> | 1 |
| | (iv) <u>stops</u> apoplast pathway/ water containing ions freely
diffusing through cell walls;
<u>enables</u> active transport/facilitated diffusion through
cell membrane;
(<u>allow</u> : selective absorption, <u>not</u> : selectively
permeable) | 2 |

Page Break

- | | Answer/Explanatory Notes | Marks Available |
|-----|--|-----------------|
| (b) | (i)&(ii) curled leaf; sunken stomata; hairy stomata; thick cuticle; fewer stomata; <u>more</u> hairs on leaf
(Any 2) | 2 |
| (c) | K ions pumped in (requiring ATP)/starch converted to malate;
<u>decrease</u> water potential of cells/increase solute potential;
<u>water</u> drawn in by osmosis/follows concentration gradient;
<u>guard</u> cells become turgid;
<u>uneven</u> thickening of Guard cells; push cells apart
(3 max) | 3 |

[10]

21.

a	(a) Endodermis correctly labelled.	1
	(b) Xylem correctly drawn, no more than 5 arms, Labelled xylem and phloem.	1
	(c) (i) clear drawing correctly labelled casparian strip	1
	(ii) <u>notes</u> to include	
	<u>waterproof</u> Casparian strip / band	1
	<u>water</u> travelling along apoplast/wall (by diffusion)	1
	<u>water</u> forced to enter symplast/lumen	1
d	Nitrogen enters as nitrate/ions Ions pass through cortex / apoplast by <u>diffusion</u> Ions cannot pass Caparian band Endodermis takes up ions by active transport (Any 3)	3 Total 10

22.

- (a) Clearly labelled vascular bundle (1)
Clearly labelled stomatal position on inner surface (inside towards bottom of pits). (1)
- (b) Transpiration (1)
- (c) Xerophyte (1)
- (d) 1. Rolled leaves (1)
Reduced surface area from which transpiration can occur/trapped moist air reduces diffusion gradient (1)
- 2. Sunken stomata (1)
In pits/on internal surface so moist/humid air is trapped/reduces diffusion gradient (1)
- 3. Hairs (1)
Hairs trap moist air and reduce diffusion gradient (1)
- 4. Thick cuticle (1)
Waxy covering reduces water loss from leaf surfaces (1)

Any 3 of the **matched** pairs

Total = 10 marks

Essay Mark Schemes

1.

A	Xylem transports water (and mineral salts) (from the roots to leaves).	1
B	Phloem transports the soluble products/sucrose/sugars/organic molecules/amino acids/source to sink of photosynthesis from leaves to other parts of the plant. (not: glucose)	1
C	Xylem is made of vessels and tracheids.	1
D	Xylem vessels form continuous tubes/ lose end walls (to carry water throughout the plant).	1
E	Their (secondary) wall is lignified to waterproof and/or strengthen/or support them/stop them (collapsing under suction/tension).	1
F	Mature Xylem vessels are dead and cytoplasm has gone so there is nothing to impede flow.	1
G	Tracheids have tapered ends that fit together and/or pits to allow transfer of water between cells.	1
H	Phloem is made of sieve tubes and companion cells.	1
I	Sieve tube cells lose most of their organelles/are still alive when mature.	1
J	Sieve tube cells have perforated sieve/end plates that allow solutes/sugar to pass through.	1
K	(Sugar solution) flows in both directions.	1
L	Companion cells have all the organelles/communicate by plasmodesmata/are responsible for keeping sieve tube cells alive/provide ATP	1
M	Any reference to fibres or parenchyma in either.	1
N	Cohesion-tension/capillarity/adhesion in xylem. Correct use of terms with ref. water molecules.	1
O	Correct use of terms in correct context: Reference to mass flow/cytoplasmic streaming/protein filaments in phloem.	1

10 MAX

2.

- A. Transpiration is the loss/evaporation of water (vapour) from (inside) the leaves (and stem) of a plant;
- B. Through stomata;
- C. Down a water potential gradient;
- D. High TEMPERATURE increases (Rate of) Transpiration / ORA;
- E. Correct explanation of effect of temp / increased kinetic energy / rate of movement of water molecules;
- F. Increased AIR MOVEMENT / eq which increases (Rate of) Transpiration / ORA;
- G. Correct explanation of effect of wind / increasing diffusion gradient;
- H. High HUMIDITY which decreases (Rate of) Transpiration / ORA;
- I. Plus correct explanation / decreased diffusion gradient;
- J. High LIGHT INTENSITY which increases (Rate of) Transpiration / ORA;
- K. Because it causes stomatal opening;

7 Max

- L. Set up under water / with a continuous column of water / make sure air cannot get in / it is air tight / equilibration;
- M. Any description of how to change one factor / may be apparent on diagram;
- N. Volume of water / movement of bubble taken up per unit time is measured;
- O. To give a (close) approximation of transpiration rate;

3 Max

Question Total 10

3.

- (i)
- A Transpiration is the (evaporative) water loss from leaves
 - B this takes place by diffusion through the stomata
 - C ~~Any factor which increases the water potential gradient between the spongy mesophyll cells of the leaf and the atmosphere~~ increases the rate of transpiration.
 - D Transpiration is increased by a rise in temperature
 - E ~~which~~ provides additional kinetic energy for the movement of water molecules.
 - F increase in air movement
 - G reduces the thickness of air / removes diffusion shells / removes water molecules from the leaf's microclimate
(~~not~~: blows water away)
 - H low humidity (increases water loss)
 - I an increase in light intensity
 - J causes an increase in the degree of stomatal opening
 - K these factors (do not act independently but) interact with each other.
 - L appropriate sketch graphs

(Any 7 points)

- (ii)
- M Thick cuticle - reduces water loss through epidermis / ~~cuticular~~ transpiration (not waterproof layer)
 - N Rolled leaves - reduces leaf area / traps water vapour (not prevents or stops)
 - O Sunken stomata - reduces diffusion / water potential gradient
 - P Hairs - trap water vapour / decrease effect of moving air

(Any 3 points)

(Total 10 marks)

4.

- | | | | |
|-----|----|--|---|
| (i) | A. | Each sieve tube has a companion cell alongside. | 1 |
| | B. | At each end of the sieve tube are perforated sieve plates. | 1 |
| | C. | Cell cytoplasm/protein strands continuous through sieve plates. | 1 |
| | D. | Companion cells contain organelles (nuclei/ mitochondria) | 1 |
| | E. | <u>Nuclei which are lost/absent in sieve tubes/few organelles.</u> | 1 |
| | F. | Companion cells are connected to sieve tubes by plasmodesmata. | 1 |

[Four marks may be awarded from the six available]

- | | | | |
|------|----|---|---|
| (ii) | G. | Phloem transports sucrose in the plant. | 1 |
| | H. | Transported from source to sink. | 1 |
| | I. | Example of sources (leaves) and sinks (growing points, fruit, seeds, bulbs) or explanation of sources and sinks. | 1 |
| | J. | Loading of sucrose (active transport). | 1 |
| | K. | High concentration (lower WP) in sources, water taken up. | 1 |
| | L. | Hydrostatic pressure drives organic solution to sink. | 1 |
| | M. | Removal of solutes at sink (raises water potential). | 1 |
| | N. | One example of problem with hypothesis (bi-directional movement, ATP consumption/no function for sieve plate/ barrier.) | 1 |
| | O. | Some mention of an alternative or additional hypothesis (cytoplasmic streaming, <u>electrosmosis</u>). | 1 |

[Six marks can be awarded from the nine available for (b)]

[10]

5.

- (a) (i) A loading of sucrose;
B into sieve tube cells/at source
C by active transport/ATP/energy dependent;
D sucrose lowers water potential (of sieve tube cell);
E water moves down water potential gradient;
F by osmosis;
G (high) hydrostatic pressure generated;
H sucrose unloaded/removed at sinks/roots;
I used for respiration/storage/converted to starch;
J water passes out of sieve tube cell;
K low hydrostatic pressure at sink/root;
L pressure gradient from source to sink/along sieve tube;
M water plus dissolved substances/sucrose/assimilates
flow down gradient; 8 max
- (ii) N ref to bidirectional flow;
O ref to no apparent role for sieve plates/companion
cells;
P ref to different rates of movement;
Q cytoplasmic streaming observed; 2 max
(Incorrect use of 'glucose' penalised once)
[10]

6.

(a)	mass flow depends on a concentration gradient between sources (of sugar) and sinks (for sugar)	1
(b)	leaves are sources	1
(c)	because they make sugar by photosynthesis	1
(d)	growing tissues are sinks because they use sugars (for respiration)	1
(e)	roots/storage organs are sinks/they convert sugar into starch/other storage product	1
(f)	at the source/in leaves, sugar is taken up into phloem tubes	1
(g)	the reverse occurs at sink	1
(h)	at the source/in leaves, water is drawn in by osmosis/drop in water potential	1
(i)	this causes a pressure potential/hydrostatic pressure	1
(j)	which results in movement/mass flow of sugar solution towards the sink	1
(k)	at sink/in roots sugar concentration decreases in phloem tubes so water passes out	1
		Available
(l)	water is returned to source/leaves in xylem vessels	1
(m)	the hypothesis does not account for all observations	1
(n)	example of unaccountable observations bi-directional movement/cytoplasmic continuity/mitochondria/sieve plates/any reasonable e.g. different rates of movement/not fast enough	1
(o)	one named alternative electro-osmosis, cytoplasmic streaming, potassium pumping, etc.	1
Maximum 10 marks from available 15		[10]

7.

- A enters root hair
- B by osmosis
- C water potential of root hair increases/becomes higher than surrounding cells
- D water moves into these cells
- E movement via symplast/~~symplasm~~/cytoplasm to cytoplasm
- F via plasmodesmata
- G via vacuolar pathway, vacuole to vacuole
- H down a water potential gradient
- I across cortex/cortical cells
- J via apoplast pathway/~~apoplasm~~, along cell walls
- K until endodermis
- L casparian strip prevents movement of water
- M redirected into ~~symplasm~~
- N water moves up in root xylem
- O reduces water potential in xylem of root
- P water enters xylem (from surrounding cells)
- Q active transport of salts into xylem

Maximum 10 marks

10
[10]